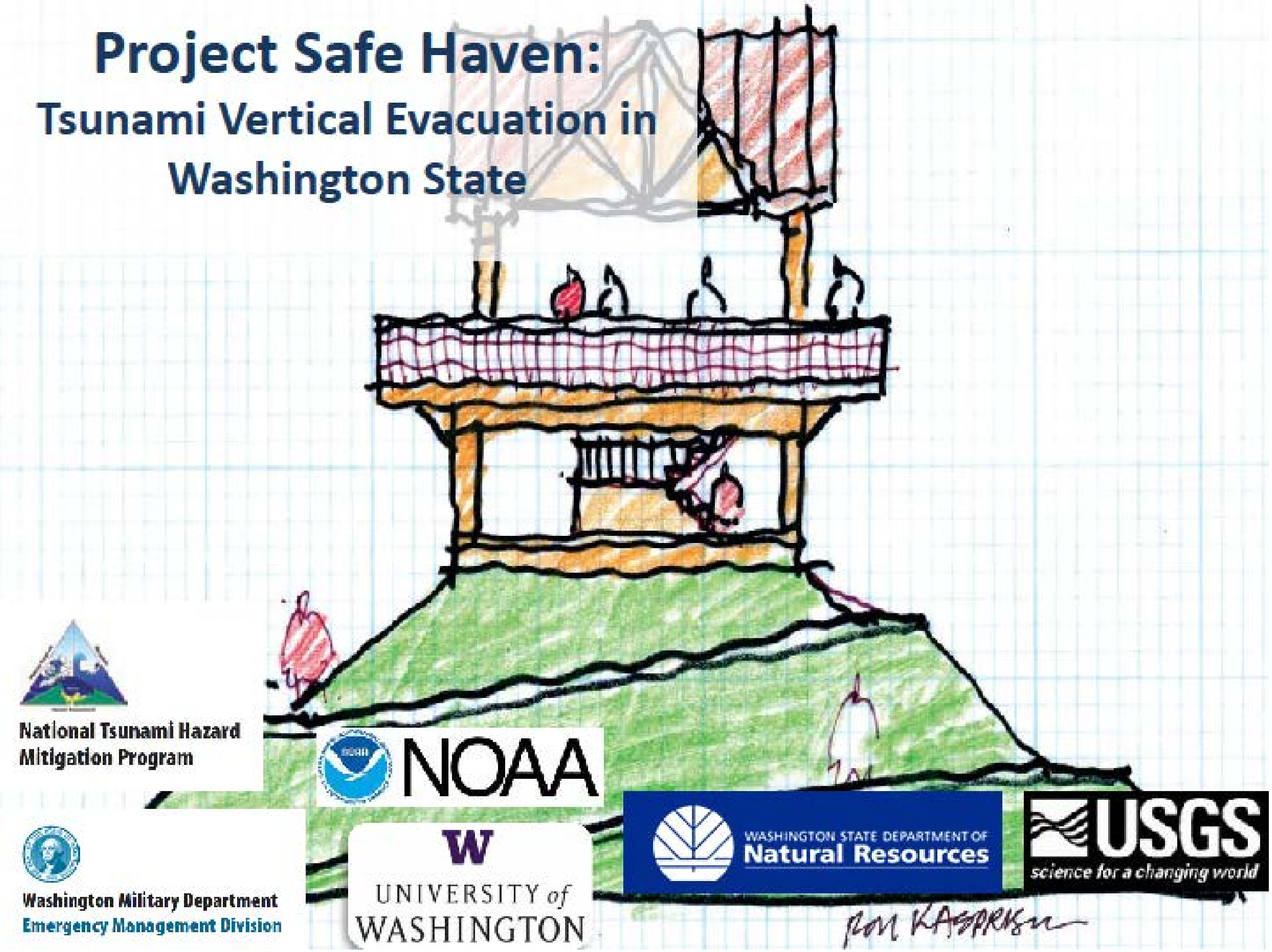
Project Safe Haven:

Tsunami Vertical Evacuation in Washington State



National Tsunami Hazard Mitigation Program

NOAA

WASHINGTON STATE DEPARTMENT OF Natural Resources

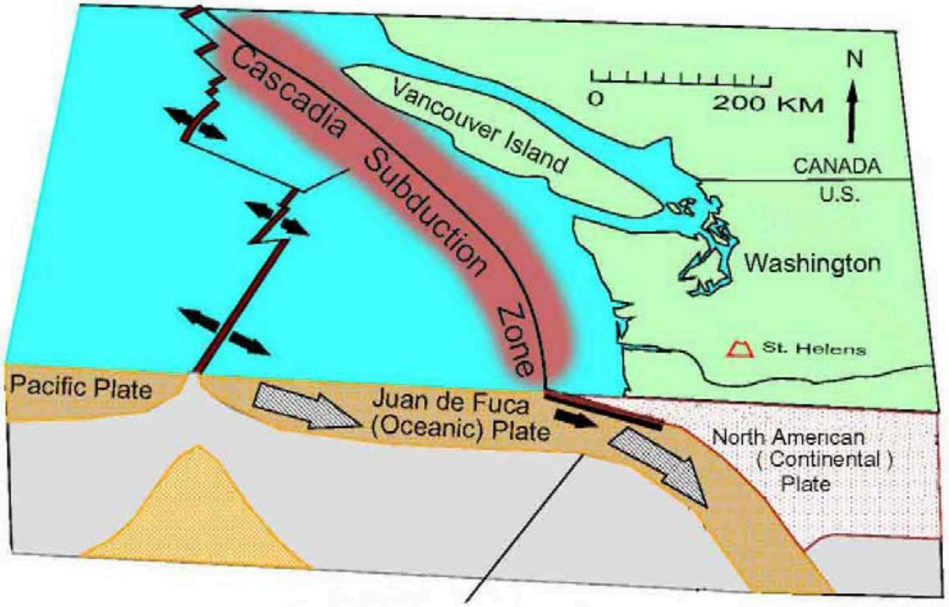
USGS science for a changing world

Washington Military Department
Emergency Management Division

UNIVERSITY of WASHINGTON

Ron Kasprisin

Earthquake Source Cross-sectional Map

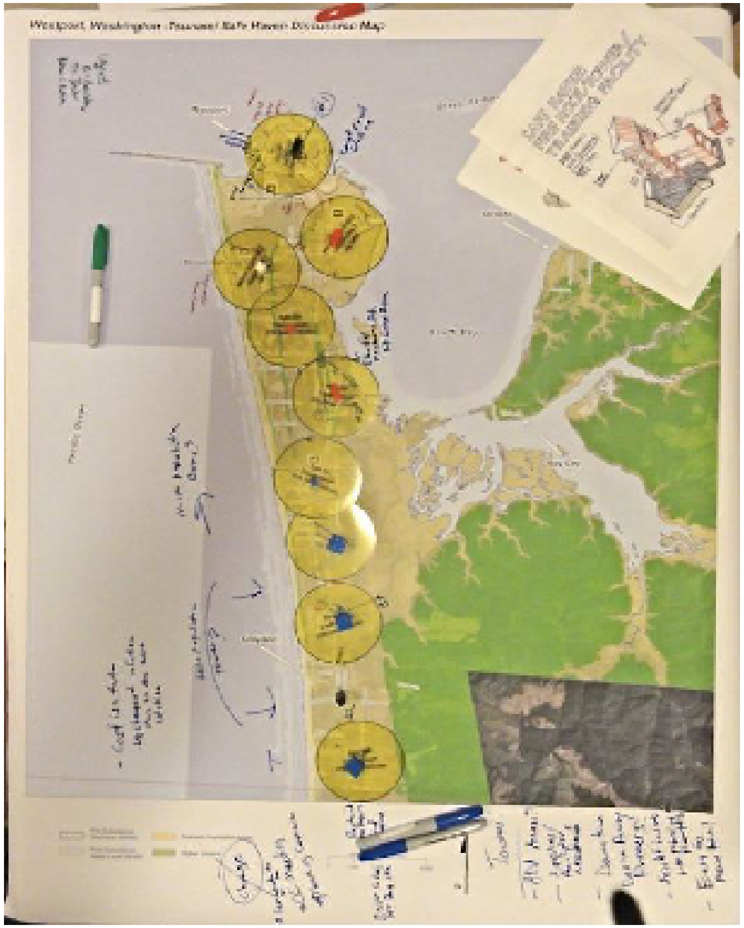


Possible source area for Subduction Zone Earthqaukes

Project Safe Haven:

- ***Community-based, 'top-down' planning approach*** (hint: the community is at the top)
- All options are on the table for consideration by community participants
- Community members provide 100% of the input, experts are on hand to answer technical questions and facilitate the planning and design meetings.

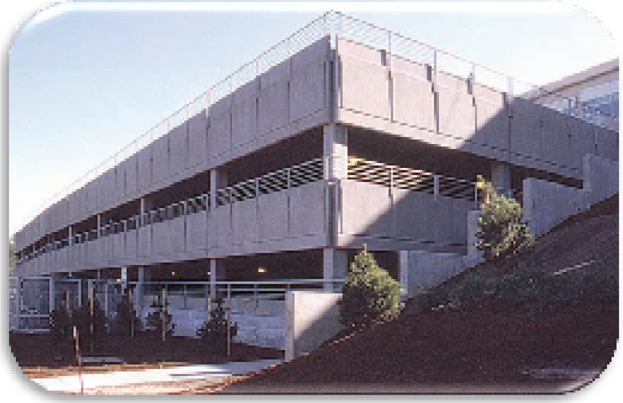
– *After all, this should be the* ***community's plan…***

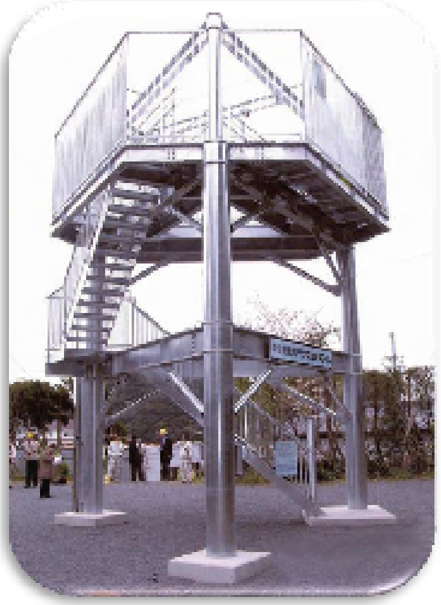


Common Themes:

- School safety!!!
- Seniors and special needs populations
- More conservative travel times – 15 min. instead of 30 min.
- Requested more conservative estimates of elevations

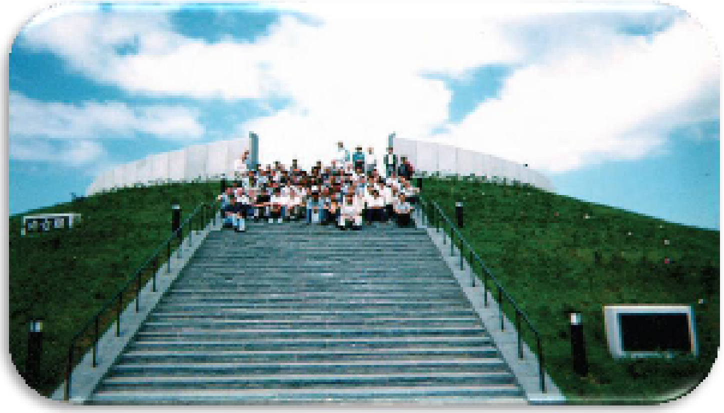
Project Safe Haven Options (from FEMA 646):





Towers –
- Limited Space
- May Blocks Views
- Few Options for Shelter

Buildings –
- Expensive
  - Better get it right the first time!
- Very Large, Likely to Block Views
- May require Private Development
  - Incentives for Height?



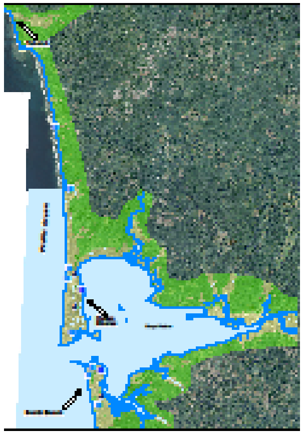
Berms –
- A Less Expensive Option
- Can be Multi-Purpose
- May be Placed to Limit View Blocking

Key Assumptions:

1. The scenario event will be a 9.1 magnitude subduction zone quake.
2. Ground Shaking will provide ample warning.
3. The wave height will be approximately 22 feet at Western shore.
4. Safe Havens will include 6 feet of safety.
5. There will be up to 40 minutes before arrival of the first tsunami wave.
6. Evacuees will need 5- 10 minutes to reorient themselves after the earthquake and will have 15 minutes to walk to a Safe Haven.
7. Healthy person can walk in 3600 feet in 15 minutes and less healthy person will be able to walk 2,700 feet.
8. Evacuees will have to remain on Safe Havens through one complete tide cycle.
9. Routes to Safe Havens will be available and discernible after the earthquake.
10. Those evacuating will walk to Safe Havens – Vehicular travel will not be available.
11. Communication will be limited to voice and radio.

Project Safe Haven: Tsunami Vertical Evacuation Opportunities in Grays Harbor County

Tsunami Hazard

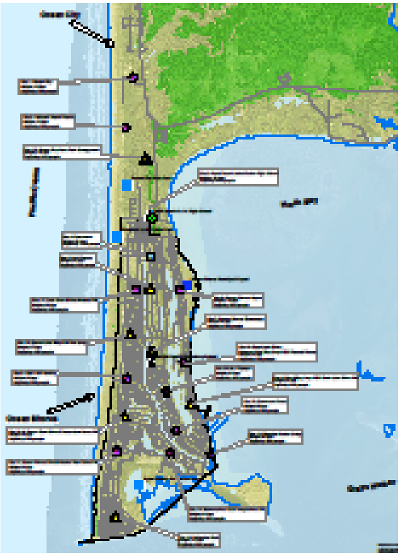


A magnitude 9+ Cascadia earthquake and tsunami — last experienced in 1700 AD — will endanger the low-lying communities along the Washington coast. Grays Harbor County's vulnerability to a tsunami combined with the difficulty of typical horizontal evacuation spurred interest in the exploration of alternative evacuation methods. A University of Washington research team, with support from county, tribal and state emergency management officials, created a community-driven process to identify potential locations for vertical evacuation in Grays Harbor County. This project addresses three of the most vulnerable coastal communities in Grays Harbor County: South Beach, Ocean Shores, and Taholah.

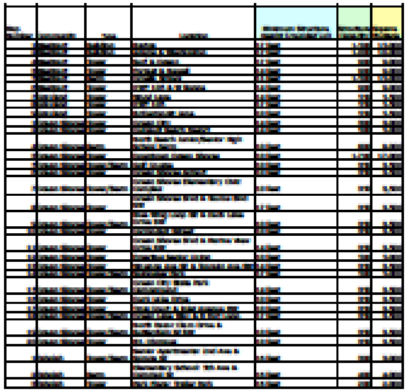
Project Approach

1. Steering Committee assembled to guide project
2. Site visit to identify opportunities for vertical evacuation
3. Conversation Café public meeting to solicit ideas and comments about vertical evacuation typologies: berms, towers, and buildings. Participants used interactive hazard maps to discuss conceptual locations for the structures, and the pros and cons of each structure type.
4. Strengths and Weaknesses public meeting to present the preliminary vertical evacuation strategy and to discuss the strengths and weaknesses. Ultimately, a preferred strategy emerged for each community.
5. Community design charrettes conducted to identify site specific design constraints and opportunities. Day-to-day functions and uses of each proposed site/structure were also explored and identified.
6. Two final open house meetings conducted to present the final strategy to allow for review of comprehensiveness, redundancy, and coordination of efforts.

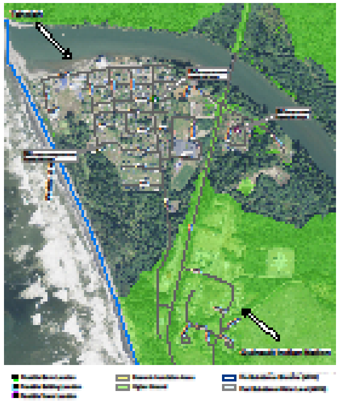
Preferred Tsunami Vertical Evacuation Strategy



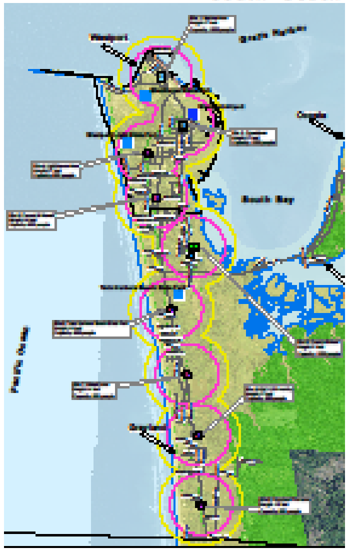
Ocean Shores



Taholah

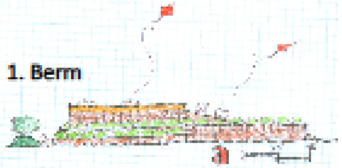


South Beach



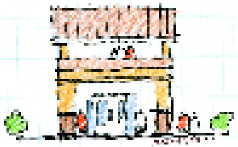
Vertical Evacuation Typologies

1. Berm



Berm structures are artificial mounds comprised of earth, rock and steel components. Berms are generally accessed by means of a sloped walkway or ramp incorporated into the berm structure. Berms can be incorporated as natural features such as land forms in less developed areas, as viewing and seating areas for athletic fields, as play areas and parks, as visitor attractions and event facilities or as noise barriers near airports and industrial areas.

2. Tower



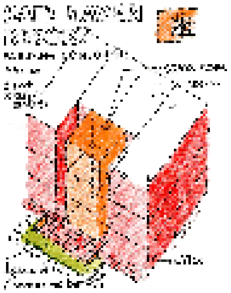
Tower structures are elevated safe zone platforms with the height greater than the width, supported by vertical structural members. Towers have a smaller footprint than berm structures for the same number of people and can be accessed by stairs, ramps, mechanical vertical assists, and manual vertical assists. Access to tower structures can be restrictive to physically challenged and aged people if stairs are the only access provided. Towers can accommodate a wide variety of alternative uses: visitor centers, in which the at-grade level acts as sacrificial office or display areas, viewing platforms for scenic and/or wildlife areas, in conjunction with community water towers, festival entry structures, elevated pedestrian bridges, among other uses.

3. Berm-Tower

Berm-tower combinations present opportunities to reduce the physical and visual impacts of larger tower structures with partial or complete sacrificial berm amendments. They also can reduce the overall footprint for a large berm structure. Berm-tower structures can provide access to tower structures if space permits, increasing access capabilities for physically challenged persons.

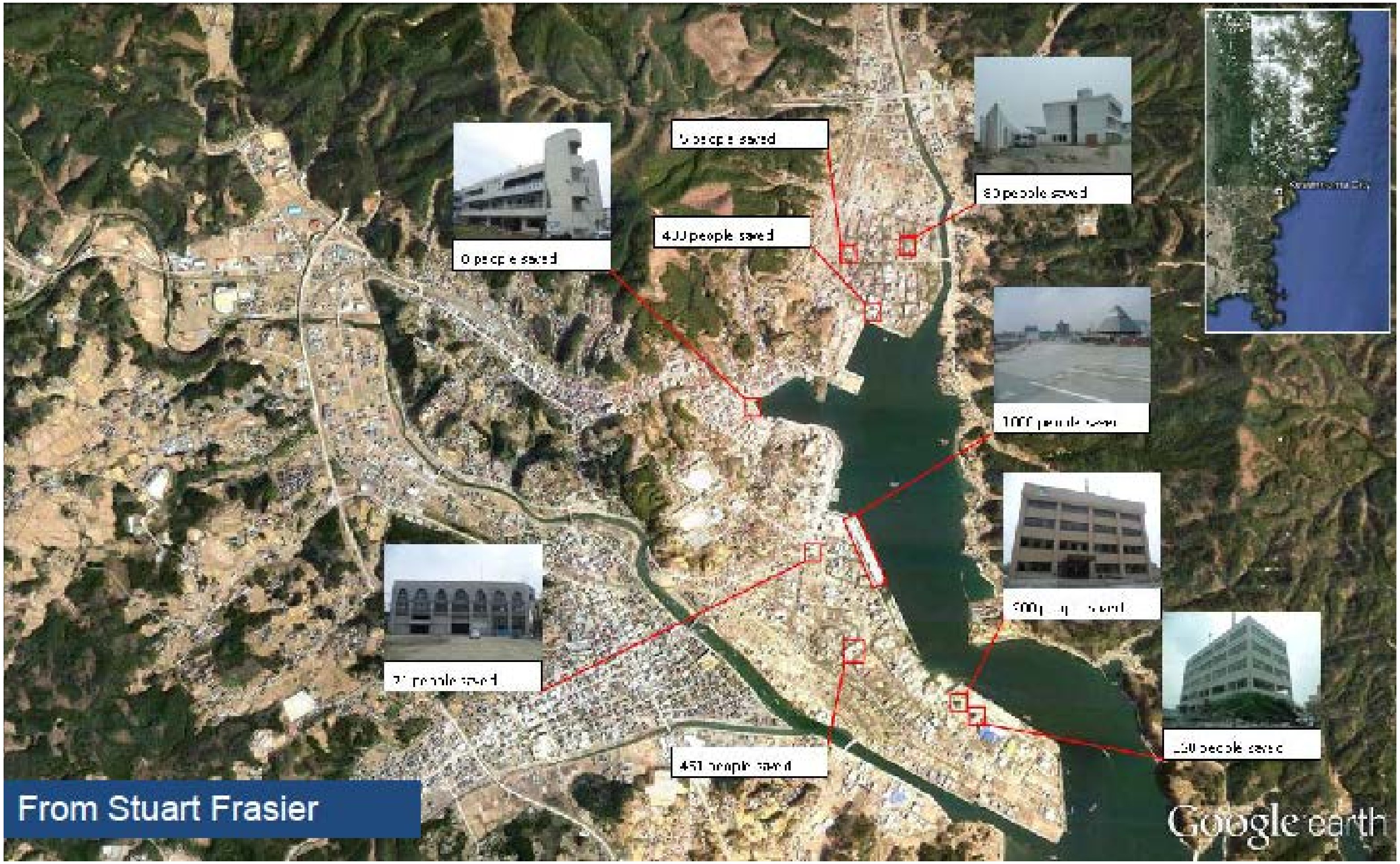
4. Building

Building designs can incorporate safe havens into an entire building or a building component. Hardening an entire building structure can be cost prohibitive for smaller communities, thus the recommendation for building components. Examples of complete building safe havens include fire stations, public works garages and other basic building structures.



Washington Military Department Emergency Management Division
FEMA
University of Washington

Because we've seen it work there!!!



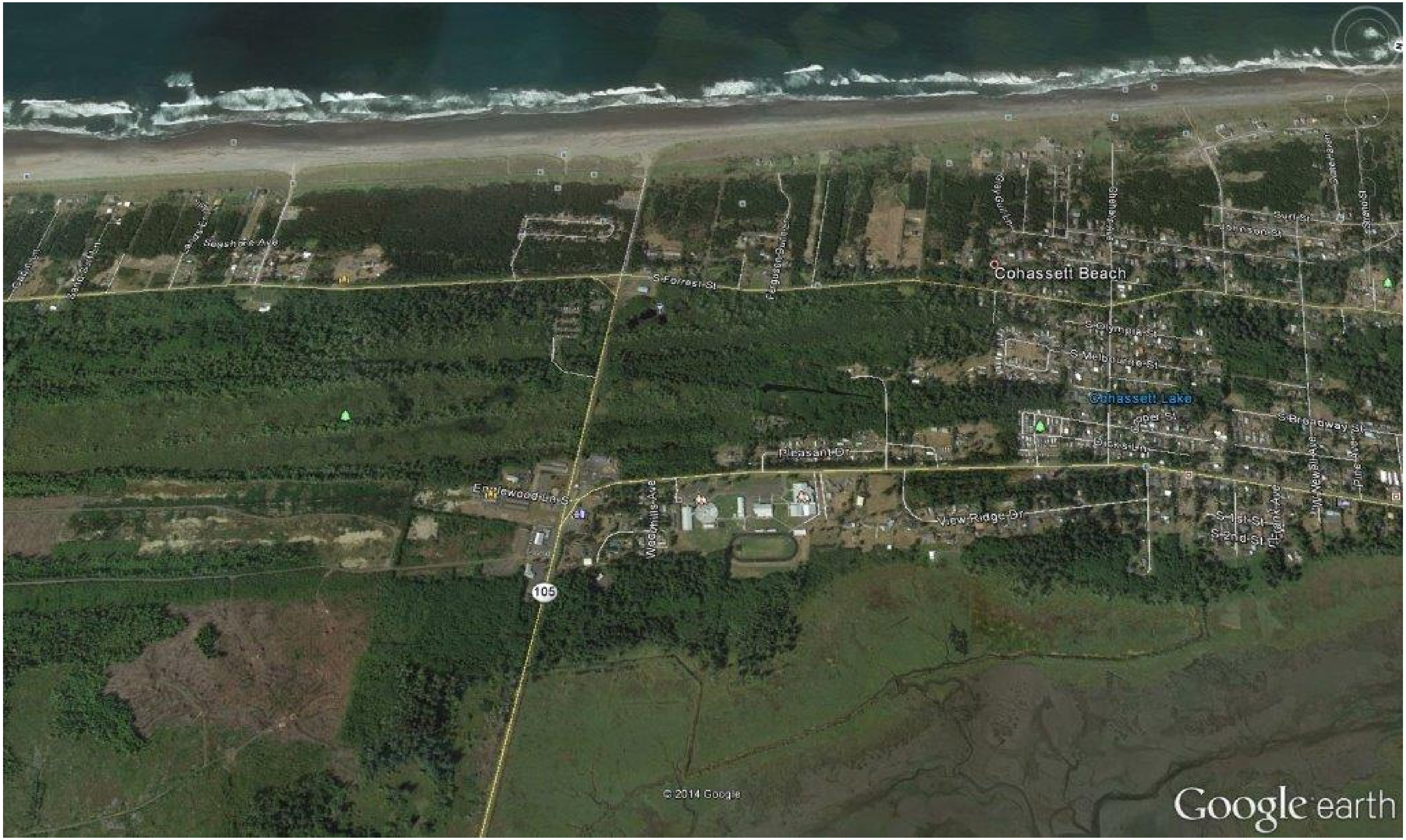
From Stuart Frasier

Ocosta Elementary School

Ocosta School District

- School elevation is 11 feet
- Expected to face 4-6 feet of subsidence
- Expect multiple tsunami waves
- ¾ mi from beach to school
- 200 yards from bay to school

- North of the city of Sendai, University of Southern California tsunami expert Costas Synolakis, found that the surge exceeded 40 foot depths a quarter-mile inland, and still reached over 26 feet high about a half-mile inland



School elevation = 11 feet
Subsidence expected to be 4-6 feet
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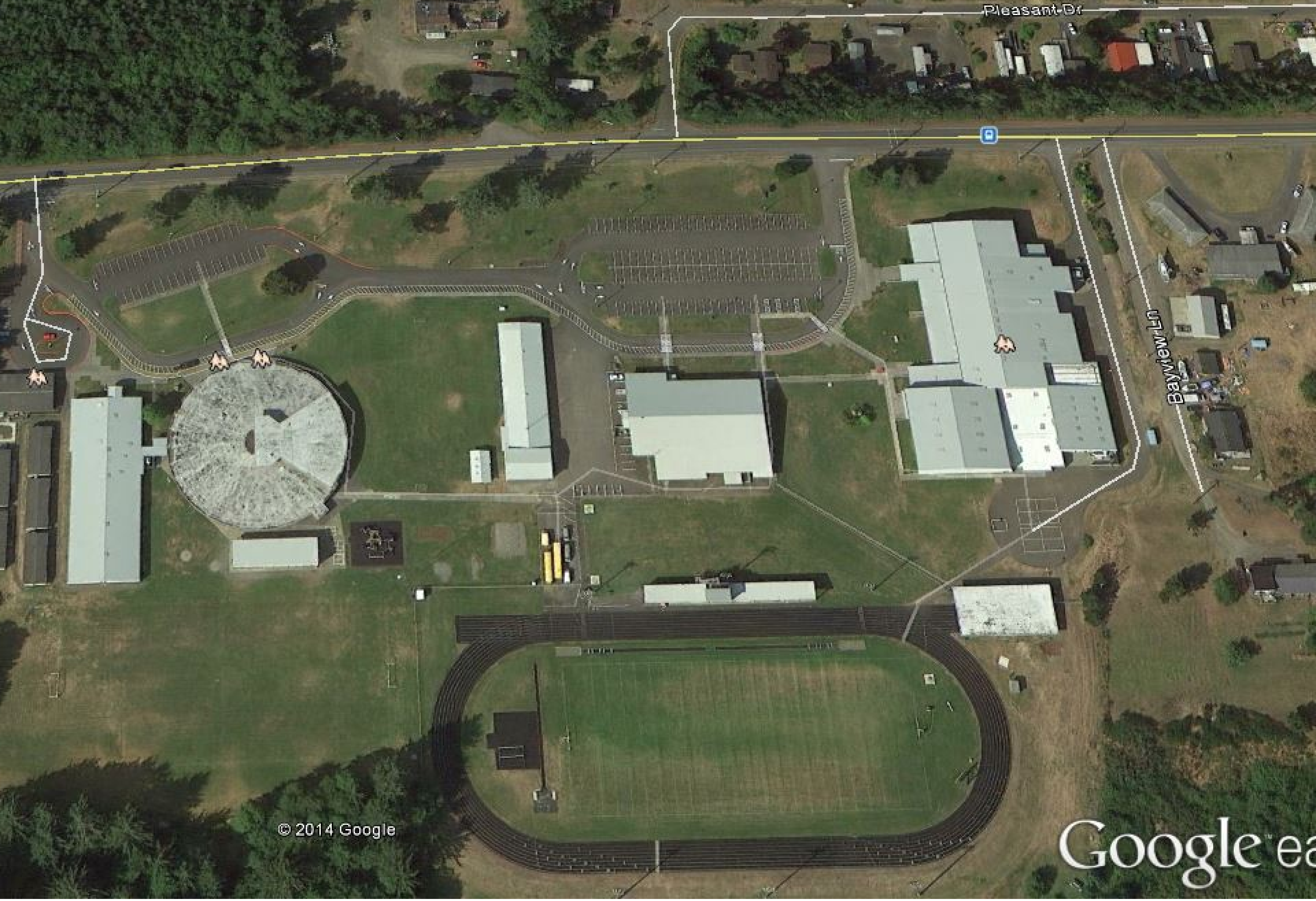
Pleasant Dr
Bayview Ln
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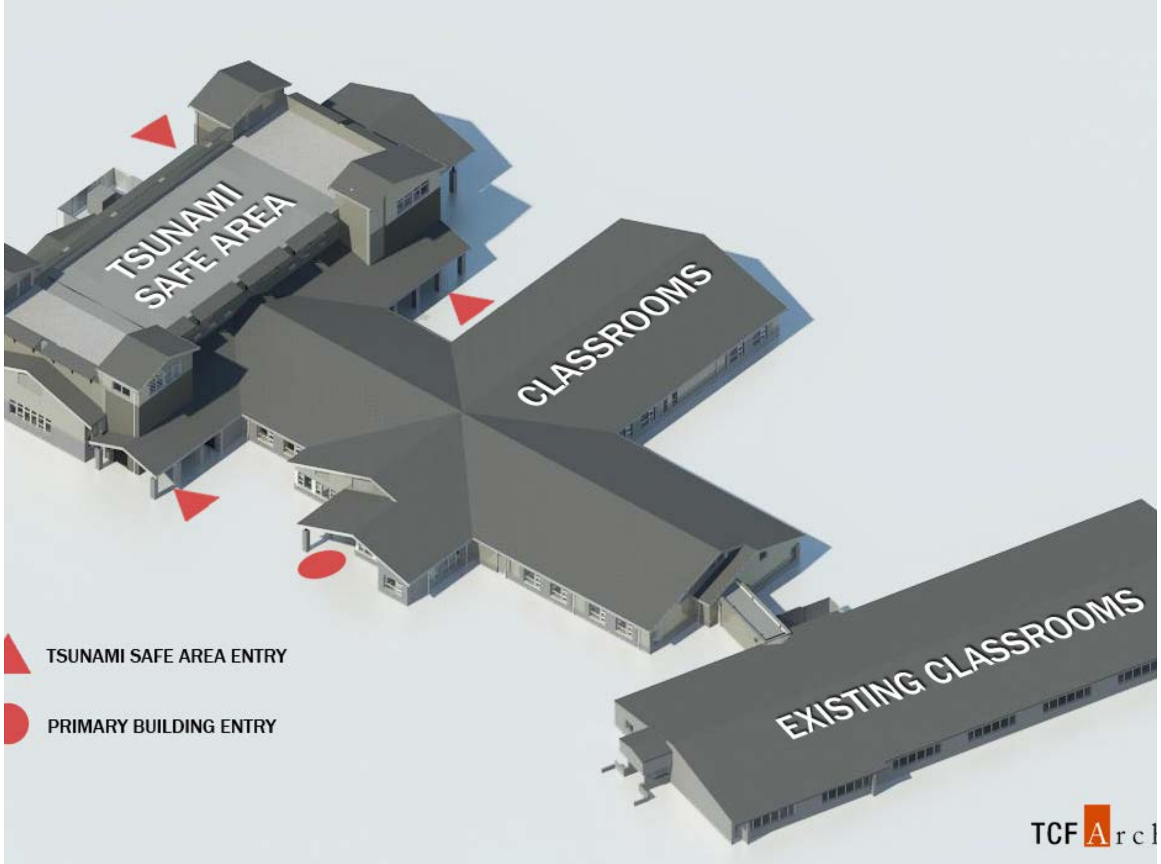


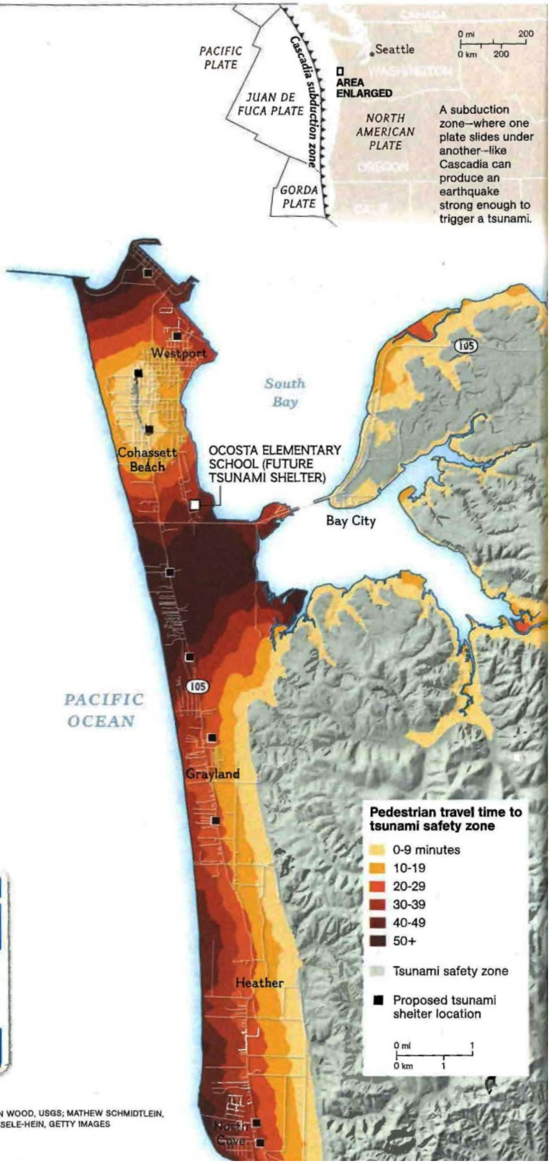
▲ TSUNAMI SAFE AREA ENTRY

● PRIMARY BUILDING ENTRY

Rooftop Refuge

Up to 5,000 people are in Westport, Washington, on a summer day. About a fifth could be too close to the coast and too far from high ground to escape on foot from a tsunami, which experts say would follow an earthquake there by 25 minutes. The city is forging a safe haven, building on state plans. Last April it approved a bond for the first vertical tsunami refuge in the U.S.—on top of a school and able to withstand a 9.2 magnitude earthquake.

"Japan's 2011 tsunami was a transitional moment in moving Westport from planning to implementation," says emergency manager John Schelling. Westport residents saw parallels between the Japanese towns and their own area: both in a potential tsunami path, both flat. So when Westport needed a new school, a tsunami plan became part of it. Rising a little taller than 55 feet, the building will allow water to pass through without compromising the structure, which can shelter 700. Planners hope that this first successful idea spawns other refuge options. *—Johnna Rizzo*



A subduction zone—where one plate slides under another—like Cascadia can produce an earthquake strong enough to trigger a tsunami.

MAP: JEROME N. COOKSON, NGM STAFF. SOURCES: NATHAN WOOD, USGS; MATHEW SCHMIDTLEIN, CALIFORNIA STATE UNIVERSITY, SACRAMENTO. PHOTO: N EISELE-HEIN, GETTY IMAGES

Ocosta Elementary School

Progress

- Construction Completion date is: May 15, 2016

- Dedication is June 11, 2016

Project Safe Haven:

Tsunami Vertical Evacuation on the Washington Coast

Washington Military Department
Emergency Management Division

PACIFIC COUNTY
PCEMA
EMERGENCY MANAGEMENT AGENCY

UNIVERSITY *of* WASHINGTON

EMERGENCY MANAGEMENT
GRAYS HARBOR COUNTY

WASHINGTON STATE DEPARTMENT OF
Natural Resources

SHOALWATER BAY TRIBE
NAHPS CHAAHTS

QUINAULT INDIAN NATION

Quileute
NATION

Makah People:
People of the Cape (qʷidiččaʔa·tx̌)